

Testimony from Kim Hornung-Marcy, resident of Williston Vermont, member of the 350Vt  
Thermal Heat Study Group

Thank you to the PUC for your service.

We already have all the technology we need to stop burning anything to produce and store electricity, heat/cool homes and to get around. Change to the best methods is made harder by false solutions, delay, and purposeful misinformation given out by industries that refuse to transition to the green solutions that already exist, are healthier, more efficient, and also cost less over time for the consumer.

When we reduce burning anything we immediately improve air quality, and the health, and longevity of Vermonters. We also help slow down climate change. We reduce the land devastation, and the water pollution caused by extracting fossil fuels or creating so called green, renewable or biofuels. Electrons are easier to transport and less polluting than fuels that burn, especially when generated by wind, and solar, and stored in batteries, which for power or heat can be made from water, or sand, not expensive rare metals.

There is no way to meet the Paris agreement to hold our emissions to 1.5 Centigrade over pre-industrial times by continuing to burn fuels. The US is a signer of this treaty, and each state needs to do its' part. There is no way Vermont can meet the Vermont Global Warming Solutions Act requirements, based on this treaty, without transitioning off burning all fuels as quickly as possible. While fossil fuels get a lot of focus, fuels that include words like "renewable", "green" and "bio" are also fuels, which when burned, cause significant health problems and climate change. These are all false solutions in improving human health, saving money, improving efficiency, and slowing down climate change.

The physics and chemistry of both human health and climate change demand we move to solutions that do not involve burning a fuel. Burning wood is the least efficient and the most toxic of all fuels currently being burned in Vermont. Wood has emissions similar to coal, wood smoke is very similar to cigarette smoke in composition and impact on human health. Vermont ranks 5<sup>th</sup> in the nation for asthma and pays huge amounts of money to manage the many health problems that air pollution makes worse. See Nick Persampieri's testimony on biomass/wood for a quote on what the health impacts of air pollution cost Vermont in health care for preventable disease and death, it is millions of dollars.

We are in a climate crisis. Whether it is the Vermont valley towns, or the hurricane impacted South, or the mountain areas of the West that are burning, this year the billions we are spending on climate disasters and the loss of life continues to rise. There is no haven from climate disasters.

Climate change itself through disasters and fires causes, serious economic impact, loss of life, often higher loss of life for areas hit, for years after the worst of the disaster is over. (<https://news.stanford.edu/stories/2024/10/study-links-hurricanes-to-higher-death-rates-long-afterstormspass#:~:text=%E2%80%9CWhen%20we%20started%20out%2C%20we,are%20related%20to%20tropical%20cyclones>). Wildfire smoke which can now travel to almost any part of our country is particularly bad for human health. Wildfire smoke causes crisis for anyone with heart/lung issues and contributes to higher mortality rates for those over 65, cancer, heart/lung disease, dementia and mood disorders. Heat which is impacting all parts of the United States is the number one climate related killer of human beings. Please see: Emergency Room doctor at

UMV Medical center, Dr Barkhuff's, editorial on wildfire smoke and heat killing people right before his eyes in Vermont:<https://vtdigger.org/2023/07/24/dr-dan-barkhuff-health-effects-of-climate-change-are-showing-up-at-the-hospital/>

In addition to Climate change causing loss of life, employment, property and health, the fuels we burn also contribute to significant health problems. The rest of this testimony will focus on what all fuels that burn emit and the health problems these emissions cause.

**The EPA recognizes six Critical Air Pollutants:** Ground-level ozone, Fine particles, Lead, Nitrogen dioxide, Carbon monoxide, and Sulfur dioxide. VOC (Volatile Organic Compounds) are also monitored because they form from Ground level Ozone and Fine particles. Fuels that burn release some or all of these health and climate wrecking substances.

**Here are the health impacts from Critical Air Pollutants created by burning fuels:**

**The Fuels that emit and The Health Impacts of Fine Particulate matter (PM2.5 and PM10):**

Formed by burning these fuels: coal, oil, natural gas, renewable natural gas, propane, Diesel, Bio-diesel, biomass/wood produces fine particulate matter at levels similar to coal. Hydrogen is in a special category while it does not produce PM2.5 or PM10 when burned it is for now mixed at about 5% with natural or renewable natural gas which does produce PM2.5 and PM10 when burned.

Health impacts are serious for exposure to any amount of fine particulate matter. "Exposure to such particles can affect both your lungs and your heart. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including: premature death in people with heart or lung disease, nonfatal heart attacks, irregular heartbeat, aggravated [asthma](#), decreased lung function, increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing." <https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm>

In addition we need to add that modern medical science accepts no amount of PM2.5 or PM10 as healthy. This study notes "no safe threshold exists for the chronic effects of PM2.5 on overall cardiovascular health. Substantial benefits would be attained by following the WHO guidelines." WHO guidelines are far more restrictive than what the EPA guidelines allow: <https://www.bmj.com/content/384/bmj-2023-076939>

In addition, this video conference from the Harvard School of Public Health on "Air Pollution and Brain Health" documents that fine particulate matter is correlated with increases in dementia and mood disorders: Go to: <https://www.youtube.com/watch?v=PUZw-jg5SiE>

I recommend and agree with the written testimony submitted by Environmental Lawyer Nick Persampieri. His statement documents extensive issues with PM2.5 and the burning of wood/biomass. According to the American Lung review of Scientific literature 2023, "wood has replaced coal in causing mortality events in many American Communities"

**The Fuels that emit and the Health Impacts from Carbon monoxide:**

All fuels that burn have the potential to produce Carbon monoxide if not burned properly and with enough oxygen. Hydrogen and green hydrogen do not produce carbon monoxide when burned but since these fuels are mainly mixed at 5% with natural gas—burning them does have the potential in that mix. What is more likely to happen is fuels, burned properly with enough oxygen form Co2 which is a very potent greenhouse gas.

A significant greenhouse gas, Carbon Monoxide interferes with the uptake of oxygen by all organisms that need oxygen to live, hence it's cause of high mortality when captured in indoor spaces. It impacts greenhouse gasses. At the source of emission, it can either combine with other pollutants to form Ground Level Ozone, or combine with oxygen to form Co<sub>2</sub>, a potent greenhouse gas causing global climate change. "Very high levels of CO are not likely to occur outdoors. However, when CO levels are elevated outdoors, they can be of particular concern for people with some types of heart disease... leading to angina." <https://www.epa.gov/co-pollution/basic-information-about-carbon-monoxide-co-outdoor-air-pollution>

#### The Fuels that emit and the Health Impacts of Nitrogen oxides:

Fuels that emit Nitrogen oxides when burned include: coal, oil, natural gas, renewable natural gas, propane, Diesel, Bio-diesel, biomass/wood. Hydrogen or green hydrogen produces up to 6 times the NO<sub>x</sub> of natural gas when burned, making mixing it at the current rate of 5% with natural gas a contributor to more NO<sub>x</sub> than just plain natural or renewable natural gas.

"Low levels of nitrogen oxides in the air can irritate your eyes, nose, throat, and lungs, possibly causing you to cough and experience shortness of breath, tiredness, and nausea. Exposure to low levels can also result in fluid build-up in the lungs 1 or 2 days after exposure. Breathing high levels of nitrogen oxides can cause rapid burning, spasms, and swelling of tissues in the throat and upper respiratory tract, reduced oxygenation of body tissues, a build-up of fluid in your lungs, and death."

<https://wwwn.cdc.gov/TSP/ToxFAQs/ToxFAQsDetails.aspx?faqid=396&toxid=69>

#### The Fuels that emit and the Health Impacts of Sulfur Dioxides:

Fuels that emit Sulfur Dioxides include: coal, oil, natural gas, diesel, biomass/wood. Special cases: Hydrogen and green hydrogen do not emit sulfur dioxide but will when burned as 5% of a mix with natural gas. Renewable natural gas, and bio-diesel produces very little sulfur dioxides, because the sulfur is mainly taken out in production. Propane does not produce sulfur dioxides.

Health impacts of Sulfur dioxide include: "irritates the skin and mucous membranes of the eyes, nose, throat, and lungs. High concentrations of SO<sub>2</sub> can cause inflammation and irritation of the respiratory system, especially during heavy physical activity. The resulting symptoms can include pain when taking a deep breath, coughing, throat irritation, and breathing difficulties. High concentrations of SO<sub>2</sub> can affect lung function, worsen asthma attacks, and worsen existing heart disease in sensitive groups. This gas can also react with other chemicals in the air and change to a small particle that can get into the lungs and cause similar health effects."

<https://www.nps.gov/subjects/air/humanhealth-sulfur.htm#:~:text=most%20urban%20areas,-,How%20can%20sulfur%20dioxide%20affect%20your%20health?,and%20cause%20similar%20health%20effects.>

#### The Fuels that emit and the Health Impacts of Ground Level Ozone:

Ground Level Ozone (main component of smog) is formed when emissions of NO<sub>x</sub> plus VOC interacts with sunlight and higher temperatures. Created by any fuel that produces these emissions which includes: coal, oil, natural gas, renewable natural gas, propane, Diesel, Bio-diesel (increases No<sub>x</sub> when blended with regular diesel fuels), biomass/wood. Hydrogen or

green hydrogen is in a special category, it produces up to 6 times the NOx of natural gas when burned and while it does not produce VOC when burned it is for now mixed at about 5% with natural or renewable natural gas which does produce VOCs when burned.

“Breathing ground-level ozone can trigger a variety of health problems including chest pain, coughing, throat irritation, and congestion. It can worsen bronchitis, emphysema, and asthma. Ozone also can reduce lung function and inflame the lining of the lungs. Repeated exposure may permanently scar lung tissue.”

<https://www.iowadnr.gov/Environmental-Protection/Air-Quality/Air-Pollutants/Effects-Ozone#:~:text=Human%20Health%20Effects,when%20ozone%20levels%20are%20elevated>

### The Fuels that emit and the Health Impacts of VOC:

Fuels that emit Volatile Organic Compounds include: coal, oil, natural gas, renewable natural gas, propane, Diesel, Bio-diesel, wood/biomass. Special consideration: Burning Hydrogen does not release VOCs but if produced by fossil fuels the production will release VOCs. Both regular and green hydrogen are so difficult to handle they will only be a small 5% mix with fossil natural gas and so VOCs will be produced in burning this mainly natural gas mixture. Renewable Natural gas produces far less VOC's than fossil natural gas, however it is often mixed with fossil gas. Such a mix will produce plenty of VOCs.

“Exposure to VOC vapors can cause a variety of health effects, including eye, nose, and throat irritation; headaches and loss of coordination; nausea; and damage to the liver, kidneys, or central nervous system. Some VOCs are suspected or proven carcinogens. VOCs in air pollution are also a concern because they contribute to the formation of ground-level ozone when they react with nitrogen oxides in the air.”

<https://www.pca.state.mn.us/pollutants-and-contaminants/volatile-organic-compounds-vocs#:~:text=and%20environmental%20concerns-,Exposure%20to%20VOC%20vapors%20can%20cause%20a%20variety%20of%20health,Learn%20more:>

### Green house Gas notes:

Hydrogen green or regular is very difficult to pipe, being the smallest molecule, it escapes easily. As an escaping gas, it is a significant greenhouse gas contributor to climate change. It is currently very expensive. When used it makes up about 5% of a mix with natural gas and because of the methane, and many critical air pollutants released by natural gas and the greenhouse gas nature of escaped hydrogen, this mix does not slow down either air pollution or climate change and may contribute more through hydrogen's production, and escape while being piped. The best use for hydrogen is in fuel cells which use a chemical not a combustion process.

Natural Gas and Renewable Natural Gas are both 97% methane. Methane leaks easily when piped, and methane is 80 times more warming than Co2 for the first 25 years after release. The best use of landfill and other sources of methane is to use it on site to generate electricity, not to liquify it and pipe it for miles as renewable natural gas.

Wood/Biomass. Burning wood/biomass releases not only large amounts of Co2, it also releases methane.

### **Health impacts from Hazardous Air Pollutants (HAPs):**

Many of the fuels we burn also release many of the 188 chemicals that make the Hazardous air pollutants list. For example: "There are over 100 hazardous chemicals released from wood burning that can be toxic and carcinogenic (cancer-causing)."  
<https://bouldercounty.gov/environment/air/wood-smoke-impacts/>

Here are just two:

#### **Benzene:**

Fuels that release benzene: oil, coal, natural gas, renewable natural gas, propane, wood, diesel, bio-diesel (especially when idling). Hydrogen itself does not but it is currently mixed at only 5% with natural gas which does.

Highly toxic to humans and animals. "Neurological symptoms of inhalation exposure to benzene include drowsiness, dizziness, headaches, and unconsciousness in humans. Ingestion of large amounts of benzene may result in vomiting, dizziness, and convulsions in humans... Can cause Aplastic anemia (a risk factor for acute nonlymphocytic leukemia), excessive bleeding, and damage to the immune system (by changes in blood levels of antibodies and loss of white blood cells) may develop... EPA has classified benzene as a Group A, known human carcinogen... Benzene causes both structural and numerical chromosomal aberrations in humans."

<https://www.epa.gov/sites/default/files/2016-09/documents/benzene.pdf>

#### **Formaldehyde**

Fuels that release formaldehyde: coal, oil, natural gas, renewable natural gas, wood/biomass, diesel, biodiesel. Hydrogen once again does not emit formaldehyde but the natural gas it is mixed with does.

"At low levels, breathing in formaldehyde can cause eye, nose and throat irritation. At higher levels, formaldehyde exposure can cause skin rashes, shortness of breath, wheezing and changes in lung function. Children, the elderly and people with asthma or other breathing problems may be more sensitive to the effects of formaldehyde. At high levels can be carcinogenic."

<https://www.atsdr.cdc.gov/formaldehyde/#:~:text=At%20higher%20levels%2C%20formaldehyde%20exposure,to%20the%20effects%20of%20formaldehyde.>